REMARKS

Claims 1-50 are pending in the application with claims 23-50 withdrawn from consideration due to the indicated Restriction Requirement. Accordingly, claims 23-50 have been canceled herewith.

Claim 8 has been objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims. Accordingly, new claims through 51 through 61 are submitted herewith, with independent claim 51 including the limitations set forth in allowable claim 8 and further including the subject matter of the intervening claims. Accordingly, a notice that claims 51-61 are allowable is earnestly solicited.

Independent claim 1 has been amended to further define that the claimed bombarding induces a surface anisotropy that produces an aligning direction on the bombarded portion of the aligning substrate. Support for the amendment is set forth in at least paragraph [0012] of the application. Accordingly, no new matter has been added.

Claims 4, 5, 7, 12, 18 and 21 have been rejected under 35 U.S.C. §112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicants regard as the invention. With respect to claims 4, 7 and claims dependent thereon, the Examiner states it is unclear with respect to which axis the azimuth angle is determined. Claims 4 and 7 have been amended to define that the azimuth angle has a reference axis that is a projection of the plasma beam on the aligning substrate. Claim 5 has been amended to replace the term "controlled" with the term "closed" which is defined in claim 2. In view of the noted amendments, removal of the 35 U.S.C. §112, second paragraph, rejection is earnestly solicited.

Claim 6 has been amended to correct a misspelled word. The amendment to claim 13 is supported in paragraph [0030].

Claim 1 has been rejected under 35 U.S.C. §102(b) has being anticipated by JP 07-056172 (JP '172) cited by Applicant. The Examiner states the abstract and Fig. 3 identically disclose the claimed process.

It is respectfully submitted that the JP '172 reference cannot anticipate nor render obvious the subject matter set forth in independent claim 1. Independent claim 1 claims

bombarding at least a portion of the substrate with a plasma beam from a plasma beam source at an incident angle of greater than 0° to about 80° thereby inducing a surface anisotropy and producing an aligning direction on the bombarded portion of the aligning substrate. As shown in JP '172, the incident angle is shown being 0° in Drawings 1 and 2, the position normal to the substrate, to an angle of about 45° as shown in Drawing 3. Applicants' incident angles are defined in paragraph [0029]. Independent claim 1 specifically claims an incident angle greater than 0°, i.e., normal incidence of the plasma beam, as liquid crystal alignment was not observed at normal incidence utilizing the method of the invention. The oblique incidence angle is an indispensable condition of the claimed method. Accordingly, in the embodiments of Drawings 1 and 2, JP '172 teaches away from the claimed invention as the liquid crystal alignment would not be observed at the normal incidence.

As disclosed in paragraph [0007] of JP '172, use of an aperture that limits the width of the beam to 20 nm is taught which limits the exposed area on the substrate. The claimed method has an intrinsic width which is generally a sheet formed by the cathodes and anode, with the width being on the order of about 1 cm. It is, therefore, not a slot as taught by JP '172. The sheet-like beam in the claimed method has principally different parameters compared with a beam in JP '172, first of all, different beam divergence.

As indicated hereinabove, independent claim 1 defines that the claimed bombarding induces a surface anisotropy that produces an aligning direction on the bombarded portion of the aligning substrate. The function of the alignment process of the present invention is to induce surface anisotropy of the alignment film. The surface is uniformly treated with the plasma beam. As best understood from paragraphs [0007], [0008] and [0009] of the JP '172 reference, the reference teaches stepwise translation of the alignment substrate or continued translation in the case of pulse-like plasma beams that results in the formation of strip-like periodic patterns parallel to the slot, wherein an actual slot is formed in the front face of the orientation film 102, such as in the form of relief grating. As known in the art, the grating aligns liquid crystals according to the Berreman mechanism. The claimed process does not modulate treatment

intensity and hence does not form patterns so that the liquid crystal alignment results from other factors. Thus, JP '172 cannot anticipate the indicated limitation.

Claims 2, 11, 13, 15 and 17 have been rejected under 35 U.S.C. §103(a) as being unpatentable over JP '172 in view of Valentian (U.S. 5,945,781).

It is respectfully submitted that the JP '172 and Valentian references cannot render the indicated claims obvious. As indicated in Col. 4, lines 42-49, Valentian teaches that the object of his invention is to remedy the drawbacks of known closed drift ion sources, and more particularly to modify them to provide greater flexibility in use. The improvements of the Valentian invention seek specifically to reduce the mass of such sources while reportedly increasing their longevity, to reportedly simply the manufacture of such sources while facilitating dismantling thereof, and to reportedly increase the mechanical strength. Accordingly, when considering the scope of the content of Valentian, namely to provide a closed drift ion source, it is unclear what a person of ordinary skill in the art would have known or could have done in order to arrive at Applicants' claimed process for preparing the aligning substrate with liquid crystals including the step of bombarding at least one portion of the substrate with a plasma beam from the closed drift thruster at an incident angle greater than 0° to about 80°, thereby inducing a surface anisotropy and producing an aligning direction on the bombarded portion of the aligning substrate. As indicated hereinabove with respect to independent claim 1, the JP '172 reference cannot anticipate the indicated limitation, and further does not teach use of a closed drift thruster. It is further respectfully submitted that only impermissible hindsight motivation can be utilized to replace the plasma beam source filed by JP '172 with a closed drift ion source by Valentian. Even though it is done, alignment principle of JP '172 (pattern formation) is totally different from the claimed process (generation of uniform surface anisotropy).

Regarding claim 11, the claimed process further includes the step of forming a liquid crystal cell comprising the aligning substrate and thermotropic or lyotropic liquid crystals. Valentian relates to a closed electron drift ion source and JP '172 relates to a manufacturing method of a liquid crystal displaying body and to the orientation treatment method, see paragraph [0001]. It is unclear from the Examiner's argument

where support exists within either of the references that would lead one to arrive at the claimed step of forming a liquid crystal cell comprising the specified aligning substrate.

Regarding claim 13, neither the JP '172 nor Valentian teach the step of placing a mask onto the substrate prior to bombarding to prevent the plasma beam from reaching a predetermined portion of the aligning substrate. Reference No. 103, an aperture, of JP '172 is not a mask. It is an indispensable element needed to produce relief patterns, but not the patterns of LC alignment produced with the help of a mask in the claimed method.

Regarding claim 15, in the claimed method, a sheet-like beam is naturally formed due to a linear geometry of plasma discharge area. The beam has a thickness growing from 1 cm (discharge area) to several cm and more with the increasing distance from the source because of substantial beam divergence. According to O. Yaroshchuk et al., Liq. Cryst., 31(6), 859 (2004), considerable divergence of the plasma beam results in two types of LC alignment (alignment modes) disclosed in the present invention. In JP '172, a very narrow beam is formed (thickness about 20 nm). Properties of this beam will be distinctly different from those in the claimed method. First of all, this beam should be much more collimated that makes impossible alignment mode characterized by LC alignment perpendicular to the incidence plane of a plasma beam

Claim 20 has been rejected under 35 U.S.C. §103(a) as being unpatentable over JP '172 in view of Sprokel (U.S. 4,261,650).

It is respectfully submitted that the Sprokel reference does not disclosure nor provide a scope and content regarding the limitation of independent claim 1 regarding the bombarding of the substrate as specifically claimed that is also lacking in the JP '172 reference. The alignment process claimed in Sprokel is a deposition process. The claimed alignment process is not a deposition process, and processing parameters, such as gaseous feed, particle's energy, etc., are different from those in Sprokel's procedure. The optimized distance between the source and substrate strongly depends on processing parameters. Moreover, Sprokel does not specifically teach that the aligning substrate is positioned at a distance of about 5 to about 50 cm from the plasma beam source.

Claims 3, 5-7, 9-10, 14, 16, 19 and 22 have been rejected under 35 U.S.C. §103(a) as being unpatentable over JP '172 and Valentian, and further in view of Sprokel and Chaudhari et al. (U.S. 6,195,146) cited by Applicants. Claims 4, 12, 18 and 21 have been rejected under 35 U.S.C. §103(a) as being unpatentable over JP '172, Valentian and Chaudhari et al., and further in view of Sprokel.

Regarding claim 3 and any claims dependent thereon, it is respectfully submitted that one of ordinary skill in the art would not be led to choose similar values for Applicants' claimed alignment processes. It is hard to compare alignment produced by particle beams generated by different sources, even though they are characterized by similar ion current and similar ion energy. This is because the beams differ in other parameters, such as kinds of particles, beam divergence, etc. As noted above, these additional factors cause different alignment modes generated by beams from a Kaufman source (U.S. 6,195,146) and closed drift source (present invention).

Regarding claims 4 and 7, JP '172 does not teach or suggest which alignment is induced at all. Claims 4 and 7 clearly describe low-pretilt and planar alignment modes. At least an alignment direction with a non-zero pretilt angle and an easy axis in the incidence plane of the plasma beam cannot be anticipated utilizing the procedure taught by JP '172. Only hindsight motivation can be utilized to modify the JP '172 reference utilizing the cited references.

As noted above, JP '172 and Sprokel disclose different alignment principles, i.e., alignment on regularly arranged periodic patterns and on the obliquely deposited film, respectively. Comparing our process with the '146 patent, the differences include (1) beam of accelerated plasma instead of an ion beam; (2) higher particle energy (>300 eV vs. <100 eV); and (3) stronger beam divergence. The latter results in two alignment modes, i.e., LC alignment parallel and perpendicular to incidence plane, in contrast to one mode (alignment parallel to incidence plane) realized in the Chaudhari reference.

Should the Examiner have any questions or concerns regarding this response, a telephone call to the undersigned is greatly appreciated.

Respectfully submitted,

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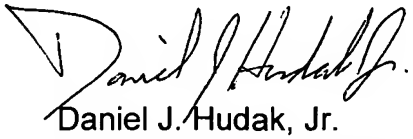

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